the <110> axis with respect to a single semiconductor substrate, wherein the concentration of the second impurity in the impurity region is in a range of 1 x 10^{18} to 1 x 10^{19} atoms/cm^3, and wherein the concentration of the second impurity in the channel forming region is in a range of 1 x 10^{16} to 1 x 10^{17} atoms/cm^3. This is different than what is disclosed and suggested by Chang.

First, the specific concentrations of the second impurity in the impurity region and in the channel forming region are not disclosed or suggested in Chang. It is respectfully submitted that it is improper for the Examiner to allege that these regions are merely subject to routine experimentation and optimization (presumably after viewing Chang). This is going too far. First, there is no disclosure or suggestion of such specific ranges. In addition, as explained on page 7 of the specification, the specified ranges in these regions are important. For example, when the concentration of the impurity in the impurity region is less than 1 x 10^{18} atoms/cm^3, the effect of the region is too weak. When it is more than 1 x 10^{19} atoms/cm^3, the device cannot function as a MOSFET. Further reasons are given in the specification as to the channel forming region.

As Chang does not disclose or suggest such concentrations, this is a clear distinguishing feature of Claim 1 (and those claims dependent thereon) over Chang. New independent Claims 29, 35, 42, and 50 also include this feature and are patentable over Chang for the same reasons.

Applicants have the following comments in response to the arguments in the prior Final Rejection.

As the Examiner agrees, Chang does not explicitly disclose that the concentration of the impurity in the channel forming region is from 1/100 to 1/10 of that in the impurity region (as specifically recited in the claims of the present application). The Examiner, however, argues that ". . . the ratio of impurity concentrations in these two regions in Chang's MOSFET is in a range substantially covering 1/100 to 1/10, given the disclosed doping dosage and the doping pocket

broaden range (vertical width) and the typical impurity concentration in a non-heavily doped channel forming region." Furthermore, the Examiner also asserts that, "the impurity concentration of the impurity doped region is a well recognized parameter of importance subject to routine experimentation and optimization."

The Examiner cites Chang, col. 3, lns. 49-61 in support of his rejection. In this section, Chang teaches that N-type impurity is implanted at a dose in a range from 3×10^{12} to 4×10^{12} atoms/cm^2, and preferably, 4×10^{12} atoms/cm^2 (col. 3, lines 49-54). Chang further states that the vertical doping location y-peak ranges from about 50 to 60 nm. The vertical broaden width of implantation y-char is at a width about 40 nm (col. 3, lines 58-61). The Examiner then alleges that the impurity concentration is roughly estimated to be about 1×10^{18} atoms/cm^3.

Applicants, however, do not agree that the Examiner's estimated value of the impurity concentration is the exact one in Chang's ion-implanted region 18. First, there is no specific recital of such values. In addition, in Chang, the sidewall spacers 15 are formed on the edges of polysilicon gate electrode 19 (col. 3, lines 29-30). Therefore, when the ion implantation is carried out, the sidewall spacers are located in the path of some of the impurity ions and block those ions from being implanted. Thus, it is not possible for all of the ions to be implanted into the region 18.

Further, in Chang there are P$^-$type LDD (lightly doped drain) regions 14, which include p-type impurity that are opposite to the n-type impurity included in the region 18. The regions 14 are also formed in the path of possible implantation (col. 3, lines 21-27). Hence, the P$^-$type LDD regions also obstruct some of the impurity ions from entering into the region 18. The Examiner's estimate of impurity concentration does not appear to take these factors into consideration.

Finally, the Examiner asserts that the non-heavily doped channel forming region normally has an impurity at a concentration in a range of 1×10^{16} to 1×10^{17} atoms/cm^2. However, there is no

evidence of the impurity in the channel region at such a concentration, and the reference fails to recite such a concentration.

Hence, the Examiner's reading of the reference and estimates of values therein, which are not recited, simply goes too far and fails to take into consideration other possible variables. Such flawed estimates cannot be the basis for a rejection of the claims of the present application.

The Examiner also concedes that there is no disclosure in Chang of the impurity being introduced from a direction of the <100> axis with respect to the single semiconductor substrate (as specifically recited in the claims of the present application). The Examiner, however, argues that the impurity doping direction in Chang can be presumed inherently along the <110> direction, because a conventional MOSFET is formed with the wafer surface being parallel to the (100) crystal plane and Chang shows in Fig. 3(c) that the implantation direction is 45 degrees to the vertical.

However, Chang merely discloses the large-angle-tilt (LATI) implant to form an ion-implanted region 18 (col. 3, lines 49-51).

In contrast, the present application explains the advantage of introducing the impurity from a direction at the <100> axis. In particularly, the specification of the present application explains that silicon has the smallest atom density on the {110} face, and that by adding an impurity ion from the <110> axis, the impurity ion can be added to a deeper position with little damage (page 4, lines 11-13). Chang not only fails to describe the exact implanting direction, but also fails to provide any mention or suggestion of the advantage of the introduction along <110> axis. Accordingly, Applicant submits that there is no disclosure or suggestion, either explicitly or inherently, of this feature of the claims of the present application.

Accordingly, it is respectfully submitted that the §103 rejection is improper, that the claims of the present application are patentably distinguishable over the cited reference and that the claims should now be allowed.

Favorable reconsideration is earnestly solicited.

Respectfully submitted,

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